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Deposited in DRO:

04 February 2010

Version of attached file:

Published Version

Peer-review status of attached file:

Peer-reviewed

Citation for published item:

Roberts, C. A. (2002) 'Tuberculosis : a multidisciplinary approach to past and current concepts, causes and treatment of this infectious disease.', in Practitioners, practices and patients : new approaches to medical archaeology and anthropology. Oxford: Oxbow Books, pp. 30-46.

Further information on publisher's website:

<http://www.oxbowbooks.com/bookinfo.cfm/ID/33493>

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3. Tuberculosis: a multidisciplinary approach to past and current concepts, causes and treatment of this infectious disease

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INTRODUCTION

'Interest in tuberculosis is at an all-time low which is striking if deaths are at an all-time high' (Farmer 1999).

Tuberculosis (TB) is an infectious disease of considerable importance as a health problem in our world today, and increasingly so (Snider *et al.* 1994). Brown *et al.* (1996) likens TB to malaria in that it has re-emerged to 'plague' populations because of the results of human behaviour. Its fascination for medical historians and researchers working in biological anthropology and, specifically, on the history of disease as identified in human remains, i.e. palaeopathology, lies in its complexity as a disease reflecting so many facets of a population's lifestyle. Clinicians and medical anthropologists working with people with TB in developing and developed countries see the disease as multifactorial in aetiology, and increasing in frequency at a rate difficult to comprehend. Described as a disease of poverty, TB has been with human and other (non-human) populations for many thousands of years, and looks set to remain in the world for the foreseeable future.

Like so many research areas in the history of medicine and disease, there has been a strong tendency over the years for researchers interested in TB to consider their particular evidence (documentary evidence or human remains) as being of primary importance, and capable of telling the story of TB. Too often we work in our own research worlds with little consideration of other perspectives. This rather short-sighted view is highlighted by the discipline of medical anthropology (McElroy and Townsend 1996), which considers health problems in a very broad sense, taking into account all aspects of a person or population's experience of 'their disease' into the final interpretation. In effect, it is the person or group of people who are the centre of concern, not the disease itself, unlike in many clinical contexts today where TB is treated (Curry 1968). In this holistic approach, where humans are viewed as 'biological organisms with a long evolutionary history, as social persons who organise systems of health care, (and) as beings who communicate and maintain cultural systems' (McElroy

and Townsend 1996, xxi), much more can be learnt of how people experience disease, what they understand about it, how they deal with it, and what the future holds. It is this broad outlook on TB that is the focus of this paper – an outlook that hopefully may encourage cross-discipline collaboration in tracing the history of disease in the future.

The aims of the paper are to consider what TB is, how frequent it is today and was in the past, what factors are important for its appearance in a population, concepts of how and why TB occurs, and how it was, and is, treated. The ultimate aim is to illustrate how it is much more fruitful, by using multiple forms of evidence, to explore the impact of TB on past populations rather than concentrating on one piece of evidence. Tuberculosis is a multifaceted disease, which, in palaeopathology, is difficult to interpret using only the evidence from human remains.

TUBERCULOSIS: THE DISEASE

Tuberculosis, an infectious disease of mammals and birds, is caused by the organisms *Mycobacterium tuberculosis* and *Mycobacterium bovis* in humans. Along with *M. africanum* and *M. microti*, these four organisms make up what is called the *Mycobacterium tuberculosis* Complex (Aufderheide and Rodríguez Martín 1998, 119). However, there are many other mycobacteria, including *M. leprae*, the organism that causes leprosy in humans. Additionally there are also what are called atypical mycobacteria, but their ability to infect humans is low; they are usually encountered in people with suppressed immune systems or in organs already affected by disease (Aufderheide and Rodríguez Martín 1998, 119). *M. avium* is one such atypical organism – one that primarily affects birds; in humans infection of bones and joints may occur (Resnick 1995, 2486). It is now recognised as a source of tuberculosis in humans (Kelley and Lytle-Kelley 1999), and is one of the organisms in the *M. avium* Complex (with *M. intracellulare* and *M. scrofulaceum*). Kelley and Lytle-Kelley (1999, 185) describe this Complex (MAC) as being 'the most common of the nontubercular mycobacteria'. The MAC has not only been associated with a number of conditions such as healed and active TB and chronic bronchitis, but has been isolated in soil, water, food, dust and other animals. Therefore, it could have been a threat to people in the past (as today) via these potential infective sources.

Tuberculosis is contracted via the lungs or tonsils through inhaling droplets containing the organism (*M. tuberculosis* and *M. bovis*), or via the gastrointestinal route through infected meat and milk of animals (*M. bovis*). This infectious disease kills three million people a year worldwide (Table 3.1). The World Health Organisation estimates that one third of the world's population is infected with TB, that there are eight million new cases each year, and that by the year 2020 it will be the fourth leading cause of death (WHO 2000).

Many factors are believed to contribute to the appearance of TB in human populations past and present (Table 3.2). Poverty, poor living conditions, and a settled way of life with high population density living in close contact with each other and infected animals, promoted the disease's appearance in the past. Travel and migration also

Table 3.1. The leading causes of death worldwide. Data from the World Health Organisation, Annual Report, 1997 (in Grange 1999).

Disease	No. of deaths annually (millions)
Coronary heart disease	7.2
Cancer (all types)	6.3
Cerebrovascular disease	4.6
Acute lower respiratory infection	3.9
Tuberculosis	3.0
Chronic obstructive pulmonary disease	2.9
Diarrhoea (includes dysentery)	2.5
Malaria	2.1
HIV/AIDS	1.5
Hepatitis B	1.2

Table 3.2. Risk factors in tuberculosis (past and present).

Risk factor	Modern	Identifiable in past populations?
Poverty	+	√
Animals	+	√
Overcrowding	+	√
Poor hygiene	+	√
Poor diet	+	√
Occupation	+	√
Travel/migration	+	√
Disasters	+	√
HIV/AIDS	+	X
Multidrug resistance	+	X
Ethnicity	+	√
Older and younger people	+	√
Build	+	√
Concept of disease	+	√
Immunosuppressive therapy	+	X

√ = identifiable using primary or secondary evidence

X = not relevant in the past or difficult to identify

exposes people to new diseases they may not have any resistance to, including TB, and migrants today often live in poverty in temporary housing (Davies 1995). Migrants also take TB to new places and expose new populations to the infection. Along with other possible predisposing factors such as a hereditary predisposition, the influence of age, sex, ethnicity, and occupation (Bowden and McDiarmid 1994), TB proves itself a complex disease. Today the main factors responsible for an increase in frequency are poverty, the presence of HIV (Human Immunodeficiency Virus) and AIDS (Acquired

Immune Deficiency Syndrome) in a person, which compromises the immune system (Raviglione *et al.* 1995), resistance to antibiotics and lack of access to health care facilities. In developing countries, contact with infected animals and their products (dung, meat, milk and blood) is also a potential way the infection can enter a human population. However, only two of these contemporary factors, poverty and contact with animals and their products, are of course relevant for the past as far as is known.

It is suggested that tuberculosis first appeared in human populations with the advent of agriculture and the domestication of animals (Steinbock 1976, Roberts and Manchester 1995). In fact, Hare (1967) suggests that the human variety of TB is a mutant of the bovine form, although this has not been supported by any definitive evidence. Whilst there have been no reports of TB in skeletal remains from hunter-gatherer populations, it is possible that TB in hunted wild animals may have been transmitted to humans during hunting and the butchery and consumption of their meat. Furthermore, some hunter-gatherer populations today are reported to have TB (Truswell and Hanson 1976). Many mammals, including humans, can be affected (O'Reilly and Daborn 1995) and, while cattle have been targeted in the past to be the animals that, once domesticated, transmitted the infection to humans, there are clearly other early domesticates such as sheep and goats that could equally have been responsible. In addition, today in Britain, badgers in the south-west of England have been labelled as transmitting TB to cattle, thus initiating a badger cull in recent years (Corbett and Harris 1991). Furthermore, it is now known that the bovine form of the disease cannot only be transmitted through eating infected meat and drinking infected milk and blood, but also by droplet infection (Grange *et al.* 1994). Tuberculosis may also be transmitted via dung from infected animals when that dung is used for fuel or as a building material. It is known that the disease-causing organisms can survive for some time outside the animal (Cosivi *et al.* 1995 and Table 3.3). Therefore, in antiquity, it is relevant to think not only of domestication of animals facilitating infection of humans, but also sharing of living space with animals. This would promote droplet infection of humans from their animals, and the use of dung for a variety of purposes. It has also been proved that humans can infect animals (Cosivi *et al.* 1995). The epidemiology of this disease is thus complex.

Table 3.3. Survival time of *M. bovis* under different environmental conditions (from Cosivi *et al.* 1995).

Contaminated material	Conditions	Survival time
Purulent emulsion	Direct sunlight	>10h but <12h
	Diffuse sunlight	At least 30 days
Cattle dung	Direct sunlight	>6h but <37h
	Diffuse sunlight	14–150 days
	Covered	365–730 days
Pasture	Temperate climate	Depends on season and climate (7–63 days)
Water (experimentally contaminated)	–	18 days

THE EVIDENCE FOR TUBERCULOSIS IN PAST POPULATIONS

Diagnosing tuberculosis today is a little easier than trying to identify it in past populations. Sophisticated diagnostic tests have developed over many years, particularly since the discovery of the tubercle bacillus and X-rays at the end of the nineteenth century. Since those discoveries, and in recent years, biomolecular methods of diagnosis have come to the fore, as they have in archaeology (e.g. Salo *et al.* 1994), which makes diagnosis a little less problematic (see below). Recognising tuberculosis in the past, however, relies not only on the archaeological evidence, but also on historical data in the form of written records and illustrations, which also provide us with a window on this infectious disease. Nevertheless, all the forms of evidence used for reconstructing the evolution and history of TB have their limitations.

Identifying the macroscopic evidence rests mainly on the skeletal evidence from archaeological sites. This is especially focused on the presence of destruction of the bony structure of the spine or Pott's disease (see Fig. 3.1), similar changes in the major weight-bearing hip and knee joints, and other features that may be the result of TB (Resnick 1995). What we assume was the disabling nature of the spinal changes is difficult to confirm due to the many vagaries affecting interpretation of disability in



Figure 3.1. Figure of TB spine in Anglo-Saxon individual from Bedhampton, Hampshire.

the past (Roberts 2000). However, diagnosis relies (preferably) on a complete skeleton (often not always possible in archaeology), and the consideration of all the possible different disease processes that could cause the changes (i.e. providing a differential diagnosis). Nevertheless, only 3–5% of people with the infection will develop the bone changes (1940s and 1950s figures – Resnick 1995, 2462), and therefore consideration of this macroscopic evidence can only reveal the tip of the iceberg of the tuberculous problem in the past. However, there is some dispute about the diagnostic criteria used for TB, i.e. there is a possibility that the clinical criteria usually accepted in palaeopathology may be flawed (e.g. see Roberts *et al.* 1998, Roberts *et al.* 1994, Roberts and Buikstra, in review). Furthermore, there is indeed an ‘osteological paradox’ in attempting to infer health from the skeleton (Wood *et al.* 1992). This landmark paper in 1992 brought together much data on the problem of identifying, analysing and interpreting the evidence of disease in skeletal remains. Many points were discussed and these included the problem of identification of disease in fragmentary remains; differentiating pseudopathological lesions, sample representivity, individual frailty and immune response in a population and its effect on the manifestation of disease in a person and their skeleton; the fact that people may die before bone damage occurs and, finally, diseases affecting the soft tissues would not be recognised solely by examining the skeleton.

Despite these limitations, developments in biomolecular methods of diagnosis have allowed previously undiagnosed tuberculous individuals to be identified (Haas *et al.* 2000). The use of ancient DNA and other biomolecules specific to a disease-causing organism, such as *M. tuberculosis* or *M. bovis*, as a method of diagnosis in palaeopathology has recently come to the fore over the last ten years. In theory, should these biomolecules survive the burial process and if there is no modern DNA contamination (see Brown and Brown 1992 for a discussion), then they may be utilised to diagnose disease. For example, a disease that does not leave its mark on bone may be identified (e.g. malaria – Taylor *et al.* 1997), and disease that killed a person before bone damage occurred may also be recognised (Haas *et al.* 2000). Ancient DNA analysis may also help confirm a possible case of TB, although proof of the presence of TB aDNA does not mean specific lesions in the skeleton were caused by the infection. More recently, methods have developed to the extent where it has proved to be possible to determine which organism of the *M. tuberculosis* Complex caused TB in the skeleton (Mays *et al.* 2001). Another development in the use of other biomolecules to diagnose TB has been the analysis of ancient mycolic acids. These molecules appear to survive better than aDNA and have been used to confirm, with DNA, a diagnosis of TB (Gernaey *et al.* 2001).

Historical data also has its problems, particularly in inferring whether tuberculosis is in fact being described or illustrated. Many terms used in past literature have been accepted as describing TB. These include consumption, the King’s Evil, scrofula, phthisis, tissick, and tabes. Whether all these terms, and at all times, actually describe what we believe today to be TB is debatable. In addition, when signs and symptoms describing this infectious disease are used as an indicator of the presence of TB, controversy arises because of the clinical features not being particularly pathognomonic, i.e. specific, to tuberculosis. For example, coughing up blood may indicate

lung cancer, and shortness of breath could relate to a number of pulmonary diseases. Likewise, the illustrations of deformities of the spine may indicate not necessarily TB of the spine, but other conditions such as osteoporosis-induced collapse of the vertebrae or brucellosis. Nevertheless, medical historians have inferred the presence and, sometimes, frequency of the disease from these data (e.g. the Egyptian figurine with a deformed back – Morse *et al.* 1964, and descriptions of TB – Meinecke 1927). However, people working in palaeopathology have always maintained that there is a lack of correlation between the frequencies of TB cited by historical sources and those revealed in skeletal remains (e.g. Roberts *et al.* 1998, 56). The fact that only a few percent of people with TB develop bone damage may be part of the explanation, but inappropriate diagnostic criteria may be another. Are the historical sources right, i.e., did the writers and artists always get the diagnosis right? Or are the frequency rates seen in the macroscopic evidence for TB in skeletons more realistic? Perhaps a rate between the two may be more acceptable, but perhaps biomolecular analysis of large numbers of skeletons in the future will potentially provide us with the real figure.

TUBERCULOSIS IN THE PAST: OLD AND NEW WORLD EVIDENCE

The primary evidence for tuberculosis comes in the form of changes in skeletal and mummified remains. If the evidence for lesions believed to be tuberculous is undisputed, i.e. by other experienced researchers, then there is near certainty of a diagnosis of tuberculosis. Of course, diagnosis is not that easy, as discussed above and also highlighted by Waldron (1994), and Miller *et al.* (1996). Written and illustrated evidence are no more reliable, because descriptions and illustrations of people with the infection are problematic in interpretation. Did that person really have TB of the spine or something else? These forms of data also rely on the author and artist getting their diagnosis right. For example, the London Bills of Mortality, which were recorded from 1562 to 1837, and chart births and deaths for parishes inside and outside of London's walls (Molleson and Cox 1993, 206), record tuberculosis (consumption) as a lead cause of death, especially in the seventeenth century AD. Were all these deaths said to be caused by consumption really TB? And was everybody who was touched for the King's Evil (believed to be TB) during the post-Medieval period a victim of TB (see below)? Cause of death data in the past (and even today) is often criticised (Evans 1998; Hardy 1994; Payne 2000). After the discovery of the tubercle bacillus and X-rays at the end of the nineteenth century, diagnosis and frequency rates may have become more accurate (although see above). Prior to this time, without efficient methods of diagnosis, TB rates may have been either over-inflated or less than the real figure.

Figures for TB in Old and New World populations over the last few thousand years rely primarily on diagnosis of TB in skeletal and mummified remains and usually also destructive lesions of the spine, as described above, on a case-by-case basis. Already we have noted that only a few percent of people with TB develop changes in their skeletons, and, therefore, absolute rates cannot be established, although it is possible to estimate a minimum number. Researchers thus report cases as 'individuals affected

in the population' rather than numbers of, for example, spines affected compared to the number available for study (Larsen 1997, 102). Nevertheless, the latter is the method most advocated for presenting data on frequency rates for disease in past human remains (see Waldron 1994 for a discussion).

The first evidence for TB in human remains from the Old World comes from Italy and is dated to 5,800 \pm 90 BP (Canci *et al.* 1996). The cave site of Arma dell Aquila also had contemporary evidence that suggested a population who were sedentary farmers who had domesticated animals and a settled lifestyle, thus suggesting that contact with animals led to TB occurring in the human population. While skeletal evidence for TB has been recorded earlier in the Old World from Jordan and dated to the eighth millennium BC (El Najjar *et al.* 1997), the evidence is not undisputed (Roberts and Buikstra in review). Many European countries, including Britain, saw increases in this infection in the later Mediaeval period (from the twelfth century onwards) when urbanism had developed and populations were living in close contact with each other, thus enabling the human form of the disease to be transmitted by droplet infection. Continuous ingestion of infected meat and milk in both urban and rural areas, and sharing of living space between humans and their animals, would also have added to the tuberculosis load in populations. Wild animals are also known to be a potential reservoir of tuberculosis and, thus, hunting and gathering groups could also have potentially have contracted TB during slaughter, butchery and consumption of hunted animals. While this is posed as a possible source of infection for earlier populations, no evidence yet has come from archaeologically derived hunter-gatherers. However, in some parts of the world, skeletons of hunter-gatherers are rather scarce, especially in the U.K., and therefore absence of evidence does not necessarily mean evidence of absence.

In the New World tuberculosis definitely appears in a pre-Columbian context (i.e. prior to AD 1492). There is a widespread distribution of cases east of the Mississippi in North America, all post-dating AD 700 (probably reflecting archaeological activity and therefore more data), a virtual absence in Mesoamerica, but also data from South America dating to as early as AD 290 in northern Chile. Thus, TB seems to have occurred first in South America and spread to North America, arriving as early as AD 1000 (Roberts and Buikstra in review). However, where are the cases from Mesoamerica if transmission was south to north? Interestingly, all Mexican examples are in the west, and it is suggested that trade along the western coast from South to North America via Mexico could have left TB in its wake as people travelled north. These data, of course, also indicate that Europeans could not have brought TB to the New World, because by that time it was well established in the Americas.

TB was undoubtedly present in both Old and New Worlds pre-Columbus, although large parts of the world still have yet to reveal their tuberculous secrets, mainly because little palaeopathological analysis is being undertaken in areas such as China, sub-Saharan Africa, India, and Russia where some of the earliest evidence for agriculture and domestication is found. The pattern of tuberculosis, and its rise and fall in humans over several thousands of years, seems set to change in future years as more data emerges. Furthermore, as more biomolecular analysis of skeletal and mummified remains, with and without TB, is undertaken with the aim of generating

positive results for the *Mycobacterium tuberculosis* complex, our numbers of cases will increase, and perhaps approach the figures suggested by historical data.

TUBERCULOSIS IN ANIMALS OTHER THAN HUMANS

We know that TB affects many animal species (O'Reilly and Daborn 1995), but if TB was originally contracted from animals then where is the evidence from non-human remains? Little of this evidence is forthcoming, but it may be unrecognised, and therefore it is unknown whether animal populations actively suffered chronic TB in the past. Domesticated animals today may show skeletal TB but it is not well described in the literature (Brothwell *pers. comm.*). However, apart from the problem of only having dis-articulated non-human remains to study in archaeology, an animal may not have lived long enough for the skeletal changes to occur, depending on what the animal was used for. Clearly, to have a knowledge of the impact of TB in non-human populations (and thus its effect on humans) requires an understanding of how TB affects the non-human skeleton – an area that is not high on the archaeozoologist's agenda, although some have promoted the study of animal palaeopathology (Brothwell 1991). Furthermore, the veterinary clinical literature is less useful for the analysis and interpretation of animal remains compared to that utilised by clinicians dealing with sick humans, and veterinary scientists do not see animals with bone changes characteristic of chronic disease. This is usually because animals are slaughtered before this can occur. Again, biomolecular analysis may identify those animals with TB but no bone change. For example, an *as yet unconfirmed* case of TB has been reported in bison bone dated to 17,000 BP from North America where the DNA of *Mycobacterium tuberculosis* complex was isolated (Martin *et al.* 2000). It should be stated that this result has not been subject to scientific peer scrutiny. However, if this analysis is accepted and verified by researchers, we have a very early case of tuberculosis in non-human remains, well before the first evidence in North America in humans.

The impact of TB on human populations around the world, according to historical data, has been very debilitating, causing great mortality and suffering. That being true, then how did people manage when the skeletal changes took their toll on the spine, hip and knee? Did people have difficulty getting about and carrying out particular tasks, or did they adapt and manage the situation well? Did they have any access to care and treatment of any sort? Did they know how they contracted the illness that caused them a problem in their lungs and affected their breathing? Did they link the debilitating changes in their spine with the disease in their lungs? Concepts of how a disease is caused often bears a direct relationship to the treatments administered and/or accepted in a population.

WHY TUBERCULOSIS OCCURS IN POPULATIONS: CONCEPTS OF CAUSATION, PAST AND PRESENT

Although the main factors today leading to TB have been discussed already, these factors may or may not be recognised or accepted by people in both developed and developing countries. It is often the case that reasons generated about how and why the disease was contracted will be determined both by a population's culture and the many facets that make up that culture (Rubel and Garro 1992, and Table 3.4). Indeed, some diseases may have an associated stigma such that people diagnosed may be ostracised from their communities, and their marriage and work prospects damaged forever. This is especially so if contracting the disease is believed to be via sinful behaviour, or is thought to run in families. On the one hand, diagnosis (preferably early in the disease's history) potentially 'nips in the bud' its progressive development, but on the other a person may suffer considerably within their social context. This latter scenario may thus lead to people who think they have the infection avoiding diagnosis, and therefore making their prospects for a recovery negligible. Ethnographic studies suggest that some groups today stigmatise individuals with TB (Hudelson 1999; Khan *et al.* 2000; Rangan and Uplekar 1999). It is seen as a disease of poverty and as a result of social and immorally unacceptable behaviour. Doctors were, and are, often loathe to diagnose the infection because they realise(d) the consequences for the patient. One wonders, therefore, whether any frequency rates for TB that were, and are, cited were, and are, accurate. A similar picture emerges with the past and present diagnosis of leprosy, another infectious disease. The stigma associated with leprosy today has even led to treatment aimed at correcting deformities so that people can return to their villages and towns and continue with their lives, not recognised as being leprosy.

Sontag (1991) describes TB as a disease compared to cancer, which consumes the body and is rapid in its progression. In the past TB was associated with romanticism,

Table 3.4. Sidama population's concepts of tuberculosis (from Vecchiato 1997).

Category	Frequency	Responses (%)
Excessive work	103	33.4
Contagion	51	16.5
Malnutrition	35	11.3
Airborne	27	8.8
Ranta	18	5.8
Natural disease (kalaqamunni)	16	5.2
Exposure to sun	10	3.2
Hereditary	4	1.3
Decreased blood level	3	1.0
Evil spirits	3	1.0
Evil eye	1	0.3
Other	6	1.8
Don't know	32	10.4
Total	309	100.0

with many characters in opera and theatre portrayed with TB (Lutwick 1995). In addition, artists and authors were apparently better at their trade if they had TB, which was allegedly supposed to inspire genius (Stirling 1997). However, at the time when these people were drawing, painting and writing, TB was a very common condition (Dormandy 1999). Therefore, it was more a coincidence that they were 'performing' and suffering from TB at the same time. Such was the case that a direct link between genius and TB was established. In addition, despite the comments above referring to the avoidance of TB diagnosis, there was a strong feeling, particularly in the Victorian period, that for young women to have TB was advantageous for marriage. To eat well was considered rude, but to appear pale, thin and weak was considered attractive to the opposite sex (Howe 1997; Sontag 1991), and people with TB were often portrayed in paintings in this way.

Focusing on Britain, for the earlier periods (i.e. before the Victorian period) it is difficult to interpret what people thought with respect to how disease was contracted and whether stigma was associated. We know, however, that Graeco-Roman physicians believed that disease was generally caused by an imbalance of one or more of the four humours, which were later equated with the seasons of the year and elements (fire, earth, water and air). Too much or too little of one or more of blood, black or yellow bile or phlegm necessitated restoration of the balance (Evans 1998). However, gods and goddesses, magical forces and other potential predisposing factors were also relevant at that time and influenced treatment (Scarborough 1969). During the Anglo-Saxon period in England, populations saw a mixture of possible causes of disease: elf-shot (arrows shot into the body by a demon); contagion (a body part affected by substances in contact with it or near it); intrusion of an object; or by poison from a creature ((flying venom) – Grattan and Singer 1952, 3). Appropriate treatments developed. Once Europe moved into the later and post-Medieval periods, religion played a strong part in people's beliefs about causation of disease. It was seen as something that had to be endured, often as a punishment for sin (Alford 1979, 389). Concepts of disease causation in the west revolved around Greek and Arabian medical traditions, which had all been translated by the fourteenth century AD (Mettler 1947, 362). Naturally, these different concepts need to be considered with respect to treatment, whose development and evolution (and success, both past and present) would have been very much influenced by them (Gatchel *et al.* 1989).

HEALING THE SICK: TREATMENT OF TUBERCULOSIS: PAST AND PRESENT

Today, where you live and how much money you have mainly determines whether you get access to treatment. Politics will, overall, prevent or enable populations to get care and recover from TB (Walt 1999, 68). Furthermore, whether a person adheres to the treatment regime is often influenced by many factors. For example, a person may feel better before the full course of antibiotics has been taken, and therefore will not take the rest of the therapy (Rubel and Garro 1992, 627). The general feeling, however, is that those least able to comply with treatment are those most likely not to. Preventative measures such as the administration of the BCG vaccine (O'Reilly and

Daborn 1995), improvement in living conditions, reduction of poverty, and treatment using multiple antibiotics to combat the infection (through Directly Observed Therapy (Short Course) or DOTS – Squire and Wilkinson 1998) are the main features of therapy for people today (Porter and Grange 1999). Traditional medicines based on herbs also feature highly in some groups (e.g. Vecchiato 1997). However, multi-drug resistance (MDR) has become a major problem today (Grange 1999).

It is difficult to assess exactly what treatments specific people with TB were exposed to in the past because direct evidence for treatment of any disease or trauma is rare in the archaeological record (Roberts and Manchester 1995). Access to care in general is also an aspect of treatment, which is unknown and was probably determined by age, sex and social status. In the past a medley of therapies appears to have been present for the treatment of disease. General therapeutic regimes included herbs, cautery (Meinecke 1927), and bloodletting (Smith 1988). However, specific herbal remedies such as lungwort (*Pulmonaria officinalis*), a herb with leaves that appear similar in appearance to lung tissue affected by tuberculosis, was one such herb recommended for TB, as indicated by both ancient and modern herbals (Potterton 1983). Resin/oil mixtures from trees, e.g. yellow amber and myrrh, also formed many bases for medicines for TB (Roberts and Buikstra in review), and turpentine, gold, iodine, copper, phosphorus and magnesium were also recommended (Bates 1992; Evans 1998; Pesanti 1995).

Diet was also important in many treatment suggestions. Often this involved ingestion of meat and milk from animals (Daniel 1997; Pease 1940). It is possible that if an animal had TB, then ingestion of it may have (if in small enough doses) induced immunity in the person. People also travelled to access a better environment, for example to the Alps (Bryder 1988), and the act of travel was also supposed to help (Daniel 1997). Sanatoria (meaning 'to heal') also developed from the seventeenth century AD to deal (some believe) with tuberculosis. They provide an environment, preferably at altitude, with lots of fresh air, a healthy well balanced diet, and graded exercise (Bates 1994; Bryder 1988; Dormandy 1999; Evans 1998). Surgery was practised in some, for example, lung collapse therapy (to rest affected lungs) and rib resection (Evans 1998). In effect, it provided a place of hope for families with relatives with the disease, and care for those afflicted. Whether they were actually effective in relieving their infection is still being debated (Evans 1998, 13). While a healthy well-balanced diet with lots of meat was advocated in sanatoria, other more unconventional dietary regimes included snails and snake excrement (Smith 1988). Another environment that people felt was beneficial to those with TB was Mammoth Cave in Kentucky, U.S.A. A constant temperature and humidity apparently provided a good healing place for people, and stone and wooden huts were built inside the cave. Unfortunately this treatment regime was not very successful (Mohr and Sloane 1955). Inhalation of various substances, including tobacco and burning dung, were also recommended, but in most cases were probably not very effective (Meinecke 1927). A treatment that was commonly available for people with TB in England and France was 'Touching for the King's Evil'. The king or queen of the time, from the later Medieval period onwards, was believed to be able to cure people with the disease; a gold touch-piece was provided to those touched, but if they lost it then TB would return to haunt them

Table 3.5. *Ethnobotanical remedies against tuberculosis in Ethiopia (from Vecchiato 1997).*

Sidama culture plant name	Scientific name	Effects
Arghisa	<i>Aloe megalacantha</i>	Emetic
Basu Bakula	<i>Cucumis ficifolius</i>	Emetic
Bullancho	<i>Labiatae</i>	Emetic
Daguccho	<i>Podocarpus gracilior</i>	Emetic, expectorant
Gambela	<i>Gardenia lovis totantis</i>	Emetic
Garamba	<i>Hypericum lanceolata</i> L.	Emetic, expectorant
Gatame	<i>Shefflera abyssinica</i>	Emetic, expectorant
Ghidincho	<i>Discopodium penninervium</i>	Emetic
Ma'disisa	<i>Trichcladus ellipticus</i>	Emetic, expectorant
Malasincho	<i>Clutia robusta</i>	Emetic
Nole		Emetic

(Daniel 1997; Crawford 1911). It is debatable whether the many thousands touched had the disease but, again, this form of treatment may have given people hope.

Clearly, treatments today could be more effective if people were not resistant to the antibiotics used, and all had equal access to medical care. Furthermore, if everybody lived in healthy environments (in their broadest sense) and were not malnourished, this may prevent the disease increasing in frequency. In the past, antibiotics were not available so less effective forms of treatment were followed, based on a population's concepts of how and why the disease occurred. Today, in traditional groups, more alternative methods of treatment are used (Table 3.5), even in situations where antibiotics are readily available, thus reflecting how much culture affects the outcome of disease.

CONCLUSIONS

TB is with us today and will be for many years to come until poverty is tackled, and effective therapy is developed and introduced into both developed and developing countries, with access for all. TB in the past is also seen and dates from at least 6,000 years ago; it has been with us for a long time.

Studying disease in the past necessitates a broad outlook in order to understand how people perceive the disease, its impact on populations, and why specific treatments are used. In order to do this, multiple forms of evidence must be utilised in order to provide a window on diseases that plagued our ancestors. Use of one form of evidence can bias the final picture; all forms have their limitations and must not be regarded as the final answer and explanation to all the questions we might have. Tuberculosis, as has been shown here, is one of the most complex of infectious diseases, affecting many birds and mammals, including humans, and its appearance is influenced by a wide variety of predisposing factors. In addition, the reasons suggested as to why it has occurred have varied through time and place, and this still continues to be the case. Treatment regimes have also varied and have been very much dependent

on theories of causation. Medical anthropology, clinical medicine, palaeopathology, documents and art all provide a small window on this important disease in the past but none provides the whole story. Until researchers accept this as a fact, then the history of the disease will be all the poorer. Very recent data actually now suggests that *m. tuberculosis* did not directly evolve from *m. bovis* (Brosch *et al.*, 2002).

Acknowledgements

I would like to thank the two reviewers for highlighting improvements in the text.

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